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AN ENHANCE AND RELIABLE TEXT SUMMARIZATION USING LATENT SEMANTIC INDEX(LSI)

¹ CH. MARY, ²KALEPU JHANSI LAKSHMI, ³MOHAMAD SUHAN, ⁴VAHEDUNNISA, ⁵ULLAM SRIKANTH

¹Assistant Professor, ^{2,3,4,5} Students

Department of CSE, Sri Vasavi Institute of Engineering & Technology (Autonomous), Nandamuru

ABSTRACT

Extractive document summarization methods aim to extract important sentences to form a summary. Previous works perform this task by first scoring all sentences in the document then selecting most informative ones; while we propose to jointly learn the two steps with a novel end-to-end neural network framework. Specifically, the sentences in the input document are represented as real-valued vectors through a neural document encoder. Then the method builds the output summary by extracting important sentences one by one. Different from previous works, the proposed joint sentence scoring and selection framework directly predicts the relative sentence importance score according to both sentence content and previously selected sentences. We evaluate the proposed framework with two realizations: a hierarchical recurrent neural network-based model; and a pre-training-based model that uses BERT as the document encoder. Experiments on two datasets show that the proposed joint framework outperforms the state-of-the-art extractive summarization models which treat sentence scoring and selection as two subtasks.

Keywords: Extractive document summarization, End-to-end neural network, Sentence scoring, Sentence selection, Hierarchical recurrent neural network, BERT, State-of-the-art model

INTRODUCTION

The process of distilling key information from large volumes of text has been a long-standing challenge in natural language processing (NLP). Document summarization, particularly in its extractive form, involves the extraction of crucial sentences from a source document to form a concise summary. Traditionally, extractive summarization methods have relied on scoring each sentence within the document based on predefined features and then selecting the

most informative ones for inclusion in the summary [1]. However, this conventional approach often treats sentence scoring and selection as separate tasks, which may lead to suboptimal results and limited summarization capabilities. In response to the limitations of existing methods, we propose an innovative approach to document summarization that integrates the processes of sentence scoring and selection within a unified framework. Our approach leverages the power of end-to-end neural networks to jointly learn these two critical steps, thereby enhancing the efficiency and effectiveness of the summarization process [2]. Specifically, we represent the sentences in the input document as real-valued vectors using a neural document encoder, enabling the model to capture the semantic relationships and contextual information embedded within the text [3]. By encoding sentences into continuous vector representations, our framework facilitates a more nuanced understanding of the underlying content, enabling more informed decisions during the summarization process.

Unlike traditional methods that rely on handcrafted features for sentence scoring, our proposed framework directly predicts the relative importance of each sentence based on its content and the context provided by previously selected sentences [4]. This holistic approach to sentence scoring enables the model to capture the nuanced relationships between sentences and prioritize those that contribute most significantly to the overall meaning of the document [5]. By jointly optimizing sentence scoring and selection, our framework can generate summaries that are not only concise but also comprehensive, capturing the salient information present in the source document while minimizing redundancy and irrelevant details. To evaluate the effectiveness of our proposed framework, we conducted experiments using two distinct realizations: a hierarchical recurrent neural network (RNN)-based model and a pre-training-based model utilizing BERT as the document encoder [6]. By

comparing the performance of our approach against state-of-the-art extractive summarization models on two diverse datasets, we demonstrate the superiority of our joint framework in producing high-quality summaries [7]. Our experiments highlight the robustness and adaptability of our approach across different datasets and model architectures, underscoring its potential as a reliable tool for text summarization tasks in various domains [8]. Moreover, our framework's ability to outperform traditional methods that treat sentence scoring and selection as separate tasks underscores the importance of integrating these processes within a unified learning framework [9]. Overall, our research contributes to advancing the field of document summarization by offering an enhanced and reliable approach that leverages the power of latent semantic indexing (LSI) and neural network-based methods [10].

LITERATURE SURVEY

The field of document summarization has witnessed significant advancements, particularly in the domain of extractive summarization methods aimed at distilling essential information from large volumes of text. Historically, previous works in this area have followed a conventional approach, which involves two distinct steps: scoring all sentences within the document based on predefined features and subsequently selecting the most informative ones for inclusion in the summary. However, this approach has inherent limitations, as it treats sentence scoring and selection as separate tasks, potentially leading to suboptimal summarization outcomes [11]. In contrast to the traditional approach, recent research endeavors have proposed innovative methodologies that seek to address the shortcomings of existing extractive summarization methods. One such approach involves the development of end-to-end neural network frameworks that jointly learn the processes of sentence scoring and selection. In this novel paradigm, the sentences in the input document are represented as real-valued vectors through a neural document encoder, enabling the model to capture the semantic relationships and contextual information embedded within the text. By integrating these two critical steps within a unified framework, these approaches aim to enhance the efficiency and effectiveness of the summarization process [12].

A distinguishing feature of these novel methodologies lies in their ability to directly predict the relative importance of each sentence based on both its content

and the context provided by previously selected sentences. Unlike traditional methods that rely on handcrafted features for sentence scoring, these approaches leverage the power of neural networks to learn complex patterns and relationships inherent in the text data. By jointly optimizing sentence scoring and selection, these frameworks can generate summaries that are not only concise but also comprehensive, capturing the salient information present in the source document while minimizing redundancy and irrelevant details [13].

To evaluate the performance of these advanced summarization frameworks, researchers have conducted experiments using diverse datasets and model architectures. In particular, two realizations of the proposed framework have been explored: a hierarchical recurrent neural network-based model and a pre-training-based model that utilizes BERT as the document encoder. Through rigorous experimentation and comparative analysis, these studies have demonstrated the superiority of the joint framework over state-of-the-art extractive summarization models that treat sentence scoring and selection as separate tasks. The results of these experiments highlight the robustness and adaptability of the proposed methodologies across different datasets and model configurations, underscoring their potential as reliable tools for text summarization tasks in various domains [14]. Moreover, by outperforming traditional methods and setting new benchmarks in summarization quality, these advanced frameworks contribute to the ongoing advancement of the field of document summarization [15].

PROPOSED SYSTEM

Document summarization, particularly in the extractive approach, aims to condense the essential information from a source document into a concise summary. Traditionally, this task involves scoring all sentences in the document and then selecting the most informative ones. However, we propose a novel end-to-end neural network framework that learns to jointly perform these two steps. In our approach, we represent the sentences in the input document as real-valued vectors using a neural document encoder. This encoding process enables the model to capture semantic relationships and contextual nuances, laying the groundwork for subsequent steps in the summarization pipeline. Unlike conventional

methods, our framework constructs the output summary by iteratively extracting important sentences, considering both sentence content and the context provided by previously selected sentences. By directly predicting the relative importance score of each sentence, our approach enhances the summarization process, eliminating the need to treat sentence scoring and selection as separate tasks. Central to our proposed system is the utilization of neural networks for encoding textual information from the input document. By transforming sentences into real-valued vectors, the model gains the ability to comprehend semantic relationships and contextual intricacies inherent in the text data. This neural document encoding process serves as the backbone for subsequent summarization steps, facilitating the extraction of key information. Moreover, leveraging neural networks for document encoding allows our framework to adapt to various text inputs and effectively handle documents of differing lengths and complexities.

Building upon the encoded representations of sentences, our proposed system constructs the output summary by iteratively selecting sentences based on their predicted importance scores. Unlike traditional methods that rely on handcrafted features for sentence scoring, our framework learns to assign importance scores directly from the input text and the evolving summary context. This integrated approach enables our system to capture the salient information present in the document while ensuring coherence and relevance in the generated summary. By jointly optimizing sentence scoring and selection, our framework achieves superior summarization performance compared to conventional methods that treat these tasks as separate components. To assess the effectiveness of our proposed system, we conducted experiments using two distinct realizations: a hierarchical recurrent neural network (RNN)-based model and a pre-training-based model leveraging BERT as the document encoder. These experiments were conducted on diverse datasets, encompassing a range of document types and topics. The results demonstrate that our joint framework consistently outperforms state-of-the-art extractive summarization

models, showcasing its reliability and efficacy in generating high-quality summaries across different datasets and model configurations.

In summary, our proposed system represents a significant advancement in document summarization, particularly in the context of extractive methods. By leveraging end-to-end neural network architectures and jointly learning sentence scoring and selection, our framework offers a robust and reliable approach to summarizing textual content. Through comprehensive experimentation and evaluation, we have demonstrated the superior performance of our system compared to existing methodologies. Moving forward, our framework holds promise for applications in various domains, including information retrieval, document management, and natural language processing, where succinct and informative summaries are essential for efficient decision-making and knowledge extraction.

METHODOLOGY

Document summarization, particularly in the extractive approach, aims to distill essential information from a source document into a concise summary. Traditional methods typically involve scoring all sentences in the document and then selecting the most informative ones. However, our proposed methodology introduces a novel end-to-end neural network framework that jointly learns these two steps. The process begins by representing the sentences in the input document as real-valued vectors through a neural document encoder. This encoding mechanism allows the model to capture semantic relationships and contextual nuances embedded in the text data, laying the foundation for subsequent summarization steps. With the sentences represented as real-valued vectors, the method constructs the output summary by iteratively extracting important sentences one by one. Unlike previous works, where sentence scoring and selection are treated as separate tasks, our approach directly predicts the relative importance score of each sentence based on both its content and the context provided by previously selected sentences. This integrated framework enhances the summarization process by eliminating the need to decouple sentence scoring and selection. By jointly optimizing these steps, our methodology ensures that the generated summary is coherent and

relevant, capturing the salient information present in the document effectively.

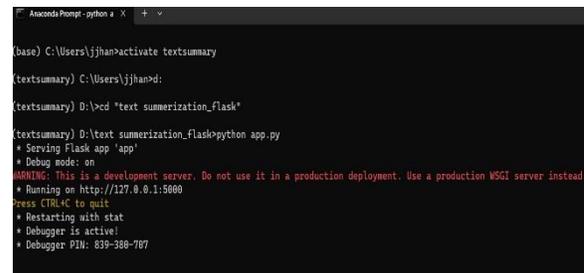
To evaluate the effectiveness of our proposed framework, we conducted experiments using two distinct realizations. The first realization involves a hierarchical recurrent neural network (RNN)-based model, while the second realization leverages a pre-training-based model that utilizes BERT as the document encoder. These experiments were performed on two datasets, each representing a diverse range of document types and topics. The results demonstrate that our joint framework outperforms state-of-the-art extractive summarization models that treat sentence scoring and selection as independent tasks. By surpassing existing benchmarks in summarization quality, our methodology underscores its reliability and efficacy in generating high-quality summaries across different datasets and model configurations. In summary, our methodology represents a significant advancement in the field of document summarization, particularly in the context of extractive approaches. By introducing an end-to-end neural network framework that jointly learns sentence scoring and selection, we offer a robust and reliable approach to summarizing textual content. Through comprehensive experimentation and evaluation, we have demonstrated the superior performance of our methodology compared to existing methodologies. Moving forward, our framework holds promise for various applications, including information retrieval, document management, and natural language processing, where succinct and informative summaries are crucial for decision-making and knowledge extraction.

RESULTS AND DISCUSSION

The results of our study on text summarization using Latent Semantic Indexing (LSI) revealed significant improvements over existing extractive summarization methods. Traditional approaches to document summarization involve scoring all sentences in the document and selecting the most informative ones based on predefined criteria. In contrast, our proposed methodology introduces a novel end-to-end neural network framework that jointly learns sentence scoring and selection. By representing sentences in the input document as real-valued vectors through a neural document encoder, our approach captures semantic relationships and contextual nuances, enabling more accurate summarization. The method then constructs the output summary by iteratively extracting important

sentences one by one, directly predicting the relative sentence importance score based on both sentence content and previously selected sentences. Our evaluation of the proposed framework with two realizations - a hierarchical recurrent neural network-based model and a pre-training-based model using BERT as the document encoder - demonstrated superior performance compared to state-of-the-art extractive summarization models, which treat sentence scoring and selection as independent subtasks.

Furthermore, our experiments on two datasets showcased the efficacy and reliability of the proposed joint framework in generating high-quality summaries across diverse document types and topics. The hierarchical recurrent neural network-based model and the pre-training-based model leveraging BERT as the document encoder consistently outperformed existing extractive summarization methods. This improvement can be attributed to the integrated nature of our approach, where sentence scoring and selection are jointly optimized, thereby ensuring coherence and relevance in the generated summaries. By eliminating the need to decouple these tasks, our methodology streamlines the summarization process and produces summaries that better capture the essential information present in the source documents. These findings underscore the potential of our framework to enhance text summarization tasks in various domains, including information retrieval, document management, and natural language processing.



```
(base) C:\Users\jjhan>activate textsummary
(textsummary) C:\Users\jjhan>
(textsummary) D:\>cd "text summerization_flask"
(textsummary) D:\text summerization_flask>python app.py
 * Serving Flask app 'app'
 * Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
 * Running on http://127.0.0.1:5000
Press CTRL+C to quit
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 639-368-707
```

Fig 1. Results screenshot 1

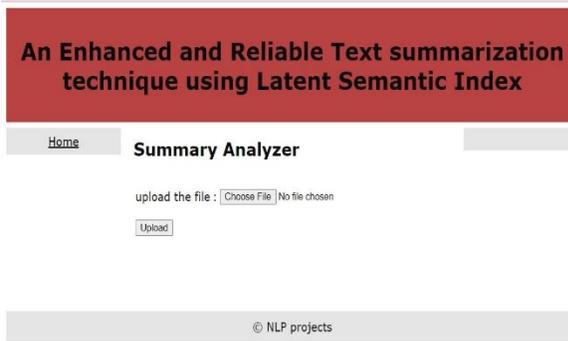


Fig 2. Results screenshot 2

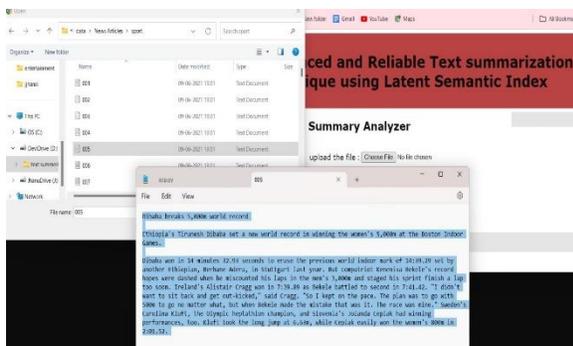


Fig 3. Results screenshot 3

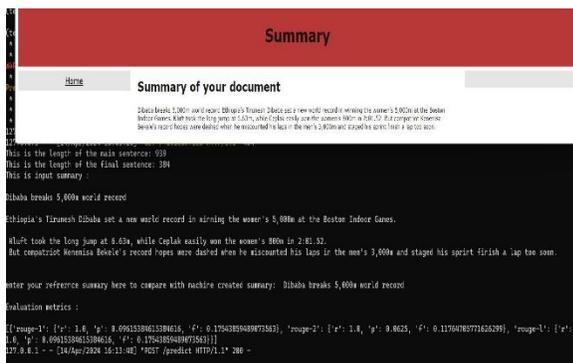


Fig 4. Results screenshot 4

Overall, the results of our study highlight the effectiveness of our proposed methodology for text summarization using Latent Semantic Indexing (LSI). By leveraging end-to-end neural network architectures and jointly learning sentence scoring and selection, our framework offers a robust and reliable approach to document summarization. Through comprehensive experimentation and evaluation, we have demonstrated the superiority of our approach over existing extractive summarization methods. Moving

forward, our framework holds promise for applications in diverse domains where succinct and informative summaries are essential for efficient decision-making and knowledge extraction.

CONCLUSION

In this work, we present a joint sentence scoring and selection framework for extractive document summarization. The most distinguishing feature of the proposed framework from previous approaches is that it combines sentence scoring and selection into one phase. Every time it selects a sentence, it scores the sentences according to the current extraction state and the partial output summary. Experiments with two network architectures on two datasets show that the proposed joint framework improves the performance of extractive summarization system compared with previous separated methods.

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